Analysis of DCC Domain Structure*

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The prospect of producing disoriented chiral condensates in high-energy collisions of hadrons or nuclei has stimulated significant interest over the past few years. However, it is inherently difficult to observe the phenomenon and it is therefore important to develop suitable methods of analysis. In order to elucidate the situation, we have applied a wavelet-like analyses to field configurations that have been obtained by dynamical calculations with the linear sigma model. The present work extends ref. [1] in two ways: 1) we further develop the analysis methods so that more realistic situations can be addressed, such as three-dimensional pion field configurations, and 2) we apply the various analyses to more realistic scenarios containing pion field configurations that have been generated by dynamical simulations of the conditions expected to occur in the course of actual collisions.

Our analyses suggest that it is important to restrict the experimental acceptance to small domains of suitable shape so as to avoid the attenuation caused by the sampling of uncorrelated pions. Thus, for example, in addition to binning the soft pion yields according to rapidity (and concentrating as far as possible on the softest pions), it would be preferable to also perform an azimuthal separation. If one or more of these restrictions is relaxed, the data collection will effectively sample different isospin domains and thereby cause an attenuation of the anomalous behavior. Thus one should not expect to observe the ideal $1/2\sqrt{f}$ form of the neutral-fraction distribution, since the isospin field is never fully aligned over a volume large enough to contain several pions. This inherent limitation underscores the need for the development of suitable analysis methods to probe this type of physics.

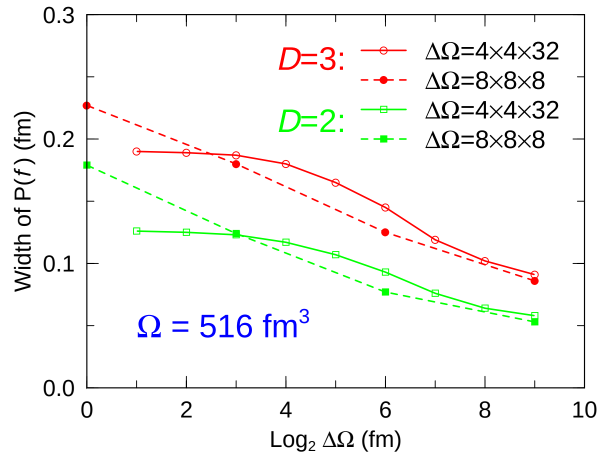

Figure 1: Width of neutral fraction distribution. The root-mean-square width Δf of the neutral-fraction distribution $P(f)$ as a function of the scale L (related to the source volume by $\Delta\Omega = 2^L\ \mathrm{fm}^3$), for both rope (solid) and cube (dashed) configurations obtained with D=2 and D=3. The neutral fraction is $f = n_0/n_\pi$, the relative abundance of neutral pions in the particular kinematic domain under analysis.

Finally, another important lesson that can be learned from the present study is that the observation of a "signal" (in the form of an anomalous form of $P(f)$) is by itself *not* sufficient evidence that a catastrophic evolution has in fact occurred. Indeed, we showed that the distribution of the neutral pion fraction resulting from a non-equilbrium process can be well approximated by the distribution associated with full equilibrium, at a suitable temperature. Therefore, in order to disentangle this degeneracy, it may be necessary to combine the measurements of pion distributions with other observables, such as electromagnetic probes.

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[1] Z. Huang, I. Sarcevic, R. Thews, and X.N. Wang, Phys. Rev. D54, 750 (1996).